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## Educating the surgeon-scientist: A qualitative study evaluating challenges and barriers toward becoming an academically successful surgeon



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**Background.** The advancement of surgical science relies on educating new generations of surgeon-scientists. Career development awards (K Awards) from the National Institutes of Health, often considered a marker of early academic success, are one way physician-scientists may foster skills through a mentored research experience. This study aimed to develop a conceptual framework to understand institutional support and other factors leading to a K Award.

**Methods.** A national, qualitative study was conducted with academic surgeons. Participants included 15 K Awardees and 12 surgery department Chairs. Purposive sampling ensured a diverse range of experiences. Semistructured, in-depth telephone interviews were conducted. Interviews were audio recorded and transcribed verbatim, and 2 reviewers analyzed the transcripts using Grounded Theory methodology.

**Results.** Participants described individual and institutional factors contributing to success. K Awardees cited personal factors such as perseverance and team leadership skills. Chairs described the K Awardee as an institutional “investment” requiring protected time for research, financial support, and mentorship. Both K Awardees and Chairs identified a number of challenges unique to the surgeon-scientist, including financial strains and competing clinical demands.

**Conclusion.** Institutional support for surgeons pursuing K Awards is a complex investment with significant initial costs to the department. Chairs act as stewards of institutional resources and support those surgeon-scientists most likely to be successful. Although the K Award pathway is one way to develop surgeon-scientists, financial burdens and challenges may limit its usefulness. These findings, however, may better prepare young surgeons to develop career plans and identify new mechanisms for academic productivity. (*Surgery* 2016;160:1456-65.)

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THE ADVANCEMENT OF SURGICAL SCIENCE requires the continued productivity of established surgeon-scientists as well as recruitment and education of new generations of surgeon-scientists. The career path for surgeon-scientists has always been arduous, but some argue that the current health care environment has made this path prohibitively challenging.<sup>1-6</sup> Many who strive for this career were inspired by mentors who were themselves described as “triple threats.”<sup>1</sup> This concept dates to Sir William Osler, who originally defined the academic physician in terms of 3 central roles: researcher, clinician, and teacher.<sup>7</sup> While the triple threat may remain possible for some, the reality of medicine today warrants deeper consideration of the challenges and barriers faced by surgeon-scientists.

Pressure for increased clinical productivity, competition from nonclinician scientists for funding, and decreased funding available for research are some concerns that threaten the sustainability of the surgeon-scientist.<sup>8-11</sup> Nonsurgeon physicians are 2.5 times more likely than surgeons to apply for any type of National Institutes of Health (NIH) career development award.<sup>8</sup> Furthermore, those surgeons who do apply for an NIH career development award are significantly less likely than their nonsurgeon colleagues to receive an award.<sup>8,9</sup> This trend has persisted: Inflation-adjusted NIH funding for surgical research decreased by 19% between 2003 and 2013.<sup>11</sup> The proportion of surgeons with NIH awards is only one quarter that of nonsurgeon physicians.<sup>9-11</sup> These reports demonstrate an alarming and potentially harmful trend. Surgeon-scientists are critical to the advancement of surgical science. Institutions, patients, and society have a vested interest in ensuring the ongoing productivity of surgeon-scientists to allow for innovation in surgical therapy.

No current pathway is considered to be the perfect way to educate a surgeon-scientist. Few studies have explored the factors that allow surgeon-scientists to succeed in their pursuits and ultimately establish themselves as independent investigators. The Association for Academic Surgery and the Society of University Surgeons Education Committees collaborated in 2014 to understand institutional support and other factors necessary for young surgical faculty to achieve academic success. The committees agreed to use a mentor-based career development award (K Award) as an objective marker of a burgeoning surgeon-scientist.<sup>12</sup> The objective of the current study was to examine and characterize the role of

institutional support for those surgeons seeking K Awards as well as the challenges they face and the factors necessary for their success.

## METHODS

**Participants and setting.** A purposive sampling method was used to recruit participants from academic medical institutions from the New England, Mid-Atlantic, Midwest, South, and West regions of the United States. Participants were eligible if they were currently employed as surgeons and either (1) funded by an NIH-sponsored Mentored Career Development Award Grant (“K Awardees”) anytime within the past 10 years or (2) employed as a chair or director of a department of surgery (“Chairs”) anytime within the past 10 years by a department with K Awardees. [Grants.gov](http://Grants.gov) was used to identify K Awardees, and purposive sampling was used to recruit participants. Potential participants were identified by the study investigators (AHH and MRK) and contacted by e-mail. No individuals explicitly declined to participate. Enrollment continued until data analysis demonstrated theoretical saturation.

**Study procedure.** Guidelines for conducting sound qualitative research were observed throughout the study.<sup>13-16</sup> A transparent data collection and analysis process was used consistently. An in-depth, semistructured interview guide with both closed- and open-ended questions was developed ([Appendix 1](#)). Questions probed various domains related to success in obtaining a K Award. The interview guide was developed with the input of various academic surgeons, including members of the Society of University Surgeons Education Committee. K Awardees were asked about their career paths, and Chairs were asked about their approach to hiring and supporting the career paths of young surgeon-scientists. The interview guide was piloted before data collection. The guide was revised throughout the period of data collection in an iterative fashion to ensure all relevant topics were explored.

Two investigators (LMK and MRK) with experience conducting qualitative research conducted the interviews. Interviews were conducted one-on-one between February 4, 2015, and July 24, 2015. The purpose, risks, and benefits of the study were discussed, and all participants gave oral informed consent. Interviews were conducted by telephone with the exception of one interview, which was conducted in person. All interviews were audio recorded. An independent professional transcriptionist reviewed all audio recordings and transcribed each verbatim. Participants were not

**Table I.** Academic surgeon participants\*

Demographics	Department Chairs (n = 12)		K Awardees (n = 15)	
	n	%	n	%
Age				
40–49	1	8.3	13	86.7
50–59	4	33.3	2	13.3
60+	7	58.3	—	—
Sex				
Male	11	91.6	11	73.3
Female	1	8.3	4	26.7
Race				
Asian	—	—	4	26.7
Caucasian/white	11	91.6	10	66.7
Black/African American	—	—	1	6.6
Other	1	8.3	—	—
Race				
Hispanic/Latino	—	—	—	—
Not Hispanic/Latino	11	91.6	15	100
Other	1	8.3	—	—

\*Participants were enrolled in the study through purposive sampling.

compensated for their participation. The Johns Hopkins Hospital Institutional Review Board approved this study and issued a waiver for Health Insurance Portability and Accountability Act Privacy Authorization.

**Data analysis.** Interview transcripts were reviewed for consistency with the original audio recordings. Data analysis was conducted per standards for methodologically sound qualitative research, as described elsewhere.<sup>13-16</sup> Two investigators (LMK and NRC) read every transcript independently and then identified general topics and themes through open coding. By comparing open coding notes, the investigators developed a codebook with a preliminary taxonomy of ideas and themes. Utilizing the constant comparison method common to Grounded Theory, the codebook was applied to the transcripts. Some codes were collapsed and others were expanded in an iterative fashion to ensure accurate representation of the data.

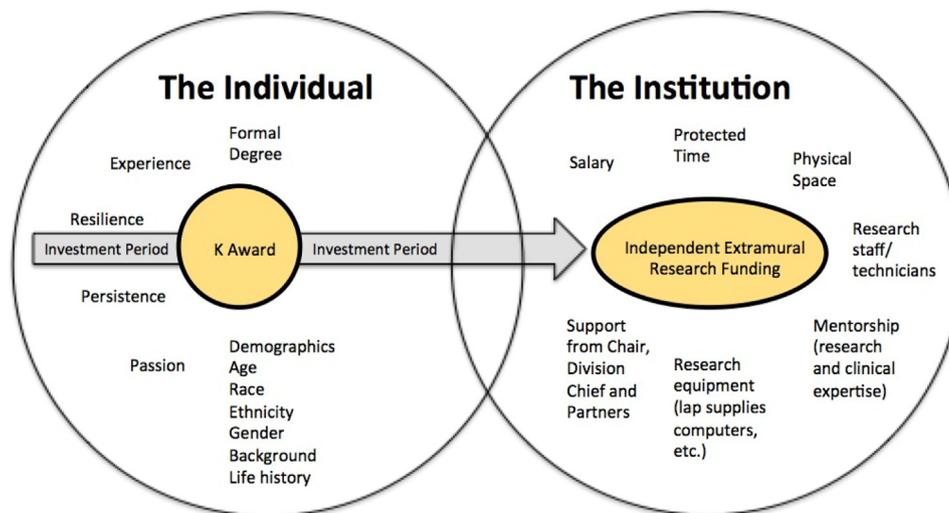
The final codebook was applied to every transcript by each of the investigators, and data were organized using ATLAS.ti (Version 1.0.0 (66); ATLAS.ti Scientific Software Development GmbH, Berlin, Germany) qualitative data software. Recurrent themes were identified. Interviews proceeded during the period of data analysis. Additional participants were sought until theoretical saturation of the data (ie, the point at which no new themes were introduced) was achieved. No interrater reliability statistics were calculated, because the 2 investigators responsible for data analysis met

regularly throughout the data analysis period to review the data and arbitrate any differences in interpretations of recurrent patterns and emerging themes.

## RESULTS

**Participants.** Participants included 15 surgeons with K Awards and 12 surgery department chairs. As a group, the Chairs were mostly men (92%), Caucasian/white (92%), not Hispanic/Latino (92%), and aged >60 years (58%). The K Awardees were nearly three quarters men (73.3%), primarily Caucasian/white (66.7%) or Asian (26.7%), not Hispanic/Latino (100%), and most were in the age range of 40–50 years (86.7%). **Table I** provides demographics for participants. The average interview for Chairs lasted 17 minutes (range 8–31 minutes), and the average interview for K Awardees lasted 19 minutes (range 12–36 minutes).

A conceptual framework emerged to describe factors that contributed to the success of surgeons pursuing K Awards and ultimately transitioning to independent extramural research funding. This framework is presented in **Fig.** Participants described both individual factors and institutional factors that contributed to success. Both K Award recipients and Chairs identified a number of challenges unique to academic surgeons. Chairs described the K Award recipient as an institutional “investment” requiring protected time for research, financial support, and mentorship. These major themes are described in **Table II.**



**Fig.** Conceptual framework: factors contributing to success of surgeons pursuing K Awards. (Color version of this figure is available online.)

Appendix 2 provides a supplementary table to complement Table II. Facilitators and barriers to success are reported in Table III. The most important implications for surgeon-scientists and Chairs, listed in Table IV, were determined by the most frequently coded themes.

**Individual factors.** Individual factors that contributed to success receiving a K Award included background, personal traits, experience, and formal research degrees. Many K Awardees recognized that their backgrounds shaped their careers, but few credited any specific demographic traits, such as age, race, ethnicity, or sex, with their personal success. Chairs did not feel that an individual surgeon-scientist's demographics influenced their decision to support the surgeon in their academic pursuits. Chairs did suggest, however, that diversity strengthens a surgical department.

Personal traits were considered some of the most critical individual factors necessary for the success of a K Awardee. Specific traits included persistence, resilience, and ability to accept failure. The needs to engage colleagues through networking, build a cohesive team, and maintain relationships with collaborators were emphasized. Passion was an influential factor described by Chairs in their assessment of young surgeons seeking K Awards.

K Awardees felt that formal, research-oriented degrees were of significant value and added credibility to their abilities. Chairs agreed that surgeon-scientists were most likely to be successful when they had received a formal master's or

doctorate degree in their research field. Although most Chairs and K Awardees thought formal degrees were helpful but not necessary, some Chairs felt formal research degrees were mandatory for all surgeon-scientists. Although Chairs recognized that some individuals might pursue additional degrees early in their career as a faculty member, they strongly preferred to support those candidates who obtained advanced degrees during their training.

**Institutional factors.** Tension was identified between the individual and the institution; personal traits were considered necessary but not sufficient without additional institutional support. Institutional support was broadly defined but included financial support, material support, protected time, and mentorship. The environment fostered by the institution was just as important, and sometimes more important, than any individual's traits or skills.

Support from the Chair and the department was paramount to success of the K Awardee; buy in was also necessary from the division chief and division partners. Division partners often manifested support through flexibility with schedules and clinical coverage. When discussing support from the department, a more nuanced truth emerged: Not every surgeon within a division could or should be a surgeon-scientist. A balance was necessary between clinically busy surgeons and surgeon-scientists, given department financial limitations. Participants suggested that larger institutions with more staff to manage clinical volume might be able to accommodate K Awardees more easily than

**Table II.** Major themes with representative quotations

<i>Theme</i>	<i>Representative quotations</i>
Individual factors contributing to a successful K award Description/examples: Personal traits, research training, research experience, formal education, background, demographics	<p>“Their history of interest and productivity in research... passion, linear thinking, ability to solve problems, a plan, and having proven that they can execute in the past.” (69-year-old Chair)</p> <p>“I think the young people now, the ones that seem to do the best are the ones that are really interested in being part of a successful team.” (48-year-old K Awardee)</p> <p>“Number one is persistence...no matter how great the environment is, you have to be persistent.” (44-year-old K Awardee)</p>
Institutional factors contributing to a successful K Award Description/examples: Financial support, physical space, mentorship, support from chair, support from division chief, support from partners	<p>“My partners were very accommodating in rearranging their schedules...and they were always willing to cover me when I was gone.” (43-year-old K Awardee)</p> <p>“If you try to go to an institution where your partners and your division chief are not on board you will fail.” (46-year-old K Awardee)</p> <p>“I don’t think I have one mentor. I’ve had, even as a junior faculty, had several mentors...technical mentors...career mentors...so I guess you need several mentors.” (47-year-old K Awardee)</p>
Challenges posed by the K award mechanism Description/examples: Financial burdens on the department, personal financial risk, ineffective surgical research training paradigm	<p>“We have less and less resources to actually accommodate surgeon-scientists at this point in time.” (47-year-old Chair)</p> <p>“The surgical personality is such that you want to be able to prove to yourself and to your colleagues that you are an excellent clinical surgeon ... the challenge is how to keep them engaged clinically and at the same time give them enough support and time so that they can pursue academic pursuits outside the pure clinical work.” (70-year-old Chair)</p> <p>“K Awards weren’t meant for surgeons. They were meant for pediatricians who have only 1 month a year of clinical responsibility, so my opinion is that K Awards are not a good mechanism.” (58-year-old Chair)</p>
The K awardee as an institutional investment Description/examples: Support for a K awardee in the form of protected time, and financial support is a complex institutional investment	<p>“I mean, it’s an investment, and it’s an important investment, but in the short-term setting there are massive financial burdens.” (48-year-old K Awardee)</p> <p>“People sort of have to have a proven track record and a very well thought out plan with mentors to be considered for the track of having protected time, because you really want to see that those individuals that obtain that are successful.” (47-year-old Chair)</p> <p>“The K Award is like a horse race in which you cheat. A horse race—ideally you put a bet down on a horse before the gate opens up and then you see which one goes around the track fastest. The K Award is like a horse race in which you put your bet down after the first turn and you see which horse can actually run.” (61-year-old Chair)</p>

smaller institutions. Similarly, larger departments may be better poised to provide financial support for K Awardees and other surgeon-scientists through endowments or philanthropic gifts.

Monetary support from the department, including salary and initial funding for research, was critical for those surgeons seeking K Awards.

The concept of institutional factors being more important than any individual factors also carried through most acutely with the financial implications. Monetary support was necessary for actual research activities, including purchasing supplies and materials, employing research personnel, and providing physical space. Many Chairs described

**Table III.** Facilitators and barriers to academic success: Perspectives of Chairs and K Awardees

	<i>Chairs</i>	<i>K Awardees</i>
Facilitators	<ul style="list-style-type: none"> <li>• Personal traits: passion for research, desire to learn and discover, resilience</li> <li>• Previous research accomplishments</li> <li>• Previous formal research education (degree and/or training)</li> <li>• Protected time</li> <li>• Financial support</li> <li>• Material support (personnel, laboratory space, etc.)</li> <li>• Effective mentorship/mentor networks</li> </ul>	<ul style="list-style-type: none"> <li>• Personal traits: persistence, resilience, passion for research, teamwork</li> <li>• Protected time from clinical duties</li> <li>• Effective mentorship/mentor networks</li> <li>• Formal research degree</li> <li>• Financial support (salary, initial research funding)</li> <li>• Personnel (technicians, statisticians), supplies, laboratory space</li> <li>• Support from chair and division chief</li> <li>• Support from partners (flexible schedules)</li> </ul>
Barriers	<ul style="list-style-type: none"> <li>• Inability to support multiple surgeon-scientists</li> <li>• Support as an “investment”</li> <li>• Smaller size of academic institution</li> <li>• Financial constraints</li> <li>• NIH salary caps</li> <li>• Pressure for increased clinical productivity from department</li> <li>• Challenges related to protection of time</li> <li>• Inadequate surgical training paradigm</li> <li>• Ineffective mentorship</li> <li>• Competition for grant funding from nonclinician scientists</li> <li>• Managing failure</li> </ul>	<ul style="list-style-type: none"> <li>• Satisfaction with clinical medicine/desire for instant gratification</li> <li>• Financial risk</li> <li>• Challenges with maintenance of clinical competency</li> <li>• Time management concerns</li> <li>• Rising from adversity/failure</li> <li>• Lack of transparency within the department</li> <li>• Lack of effective training</li> <li>• Time limit for departmental support</li> <li>• Lack of material support</li> </ul>

supplementing their surgeon-scientists’ salary support or “buying their time” with departmental funds or philanthropic gifts to ensure a salary commensurate with clinically busy peers.

Protected time, a stipulation of the K Award, was necessary for the surgeon-scientist to be successful. However, interpretations of what protected time actually meant varied among Chairs and K Awardees. Most participants indicated that K Awardees were expected only to perform clinical duties for a limited number of days per week or perhaps had only 1 week of clinical duties per month. Others described reduced relative value unit expectations, which explicitly equates to less clinical productivity. Although most participants described having adequate time for research activities, many surgeons felt that they ultimately needed to work more hours than non-surgeon-scientist colleagues to ensure success in both research and clinical arenas.

The final institutional factor, often described as the most important consideration, was mentorship. Most K Awardees described mentor networks

as opposed to a singular mentor or preceptor-type model. A concept frequently discussed was the need for both a research mentor and a clinical mentor to help with different skills and techniques. Most institutions did not have any formal mentorship-matching programs, and many K Awardees sought out their own mentors informally based on aligned interests.

Some K Awardees described seeking mentors outside of the department of surgery, and others even identified mentors at different institutions. The need for networking skills and experience in collaborating with others was paramount to successful mentorship networks. Some K Awardees had difficulty maintaining relationships with their mentors and ultimately required new and multiple mentors to ensure their continued success. No K Awardees or Chairs explicitly discussed lack of sex, race, ethnicity, or other demographic concordant mentors as a specific limitation preventing success with a K Award.

**Challenges.** Both K Awardees and Chairs identified a number of challenges unique to academic

**Table IV.** Implications for surgeon-scientists and Chairs: Top 10 lists

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Surgeon-scientists: Top 10 list to ensure institutional support for academic success

1. Protected research time
2. Salary support to offset clinical productivity demands
3. Mentorship (formal)/mentor networks
4. Initial research funds
5. Personnel (technicians, etc)
6. Laboratory space/computing infrastructure
7. Supplies (equipment, computer, etc)
8. Support from chair
9. Support from division chief
10. Support from division partners

Chairs: Top 10 list to identify candidates poised for academic success

1. Passion for research
  2. Persistence in working toward a goal
  3. Collaboration/teamwork
  4. Resilience
  5. Research training/experience
  6. Formal research degree(s)
  7. Track record of publications
  8. Clear goals and expectations
  9. Defined research plan
  10. Clinical excellence
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surgeons. The financial strain on the surgery department stemmed from salary support, research funding, and protected time, all of which came at a direct cost to the department. Some participants indicated that their institutions even discouraged K Awards for surgeons, given the financial implications. Although some older Chairs did recognize that the K Award pathway was perhaps more relevant or accessible in the past, most agreed this pathway has not kept up with the changing pace and financial considerations of modern academic surgery.

Some participants felt that pursuing a K Award and extramural funding as a surgeon-scientist was a personal financial challenge. This risk was compounded by the fact that many surgeons train for longer periods of time than their nonsurgeon peers, delay repayment of loans for a longer period of time, and have significant incentive as young faculty to pursue financial security through clinical productivity.

Other challenges stemmed from the nature of the surgical profession itself and the current surgical residency training paradigm. There was significant concern that junior faculty may devote

their time and energy early in their career to mastery of operative techniques. This is also the time period during which a burgeoning surgeon-scientist must complete preliminary research to obtain a K Award. Some participants felt the surgeon-scientist pathway and the clinical pathway were mutually exclusive given the inherent struggle between clinical mastery and time for research early in a career. Many surgeons agreed that the satisfaction of providing surgical care might prohibit many potential surgeon-scientists from seeking or sustaining a research career.

Finally, the current training paradigm was considered a challenge to maintaining a successful pipeline of surgeon-scientists. Many of the K Awardees credited their research training during residency as their motivation to pursue a career as a surgeon-scientist. However, K Awardees had to obtain support, time, and initial funding as junior faculty to conduct the type of preliminary research expected for a K Award application. Commonly, this research was in a field unrelated to the research pursued as a resident. As such, many K Awardees did not directly credit the research work completed during residency as a contributing factor to their K Award.

**Institutional investment.** Chairs described the K Award recipient as an institutional investment requiring protected time for research, financial support, and mentorship. Many Chairs recognized that some potential surgeon-scientists will not succeed and felt it was their duty to redirect unsuccessful surgeon-scientists to ensure appropriate stewardship of institutional resources. Chairs used a finite time period, typically between 2 and 5 years, to allow a surgeon-scientist to flourish. If there was no clear evidence of progress during this time, the Chair described taking action to redirect the surgeon away from the K Award/surgeon-scientist pathway. This time limit, usually made explicit to young faculty, often served as a source of motivation to achieve independent extramural funding for research.

## DISCUSSION

These qualitative results inform an important conceptual framework describing institutional support and individual factors that contribute to the success of surgeons pursuing K Awards. Although other studies have examined the development of physician-scientists in departments of medicine, relatively few studies have focused on the unique experience of the surgeon-

scientist.<sup>17-22</sup> Numerous challenges and barriers that may contribute to the relative dearth of funded surgeon-scientists are identified. The K Award mechanism is one way to train and develop surgeon-scientists, but our findings highlight the increasing importance of identifying and encouraging other mechanisms for the development of surgeon-scientists.

Financial stressors, competing clinical demands, and the current paradigm of surgical residency research training are some of the factors that may limit the development of surgeon-scientists. The K Award mechanism may present financial stressors for both the department and the individual surgeon. Furthermore, there is tension between the individual surgeon and the institution; personal traits and ability to succeed are generally not sufficient without additional institutional support. Chairs have a vested interest in protecting department resources and only supporting a limited number of candidates who are most likely to be successful.

Surgery is a labor-intensive profession, and clinical demands may limit the time available for academic pursuits.<sup>23</sup> The most successful K Award candidates are perhaps those who are able to establish their area of expertise and their preliminary findings early in their career, but the first 5 years as a faculty member is also a period when many young surgeons want to establish their clinical practice and achieve technical mastery. A number of leaders in surgery have recognized the difficulty in providing surgical faculty the same degree of protected time giving to nonsurgical colleagues.<sup>9,24-27</sup> As a consequence, many surgeons with the skills and aptitude necessary for independent investigation may lose the opportunity to establish a research career due to the demands of a competing clinical practice.

The most critical personal traits necessary for the success of the surgeon-scientist are persistence, resilience, and passion for research. Other qualitative work among nonsurgeon physician-scientists also has highlighted the importance of persistence and resilience in medical research.<sup>28</sup> These traits may be innate, but they also may be acquired through stimulating mentorship in a nurturing environment. Given the number of challenges inherent to medical research, it is critical for surgeons to have accessible forums in which to share their experiences.

Collaboration, teamwork, and networking skills were identified as essential skills for the surgeon-scientist. Furthermore, the ability to establish and maintain support from the institution was critical. Negotiation skills are important when seeking

support from the institution, including the department chair, division chief, and division partners.<sup>29</sup> Early emphasis on interpersonal skills and negotiation practices may ensure surgical residents are prepared most effectively for their future as surgeon-scientists.

Our results emphasize the importance of mentorship networks. Surgeon-scientists and Chairs both recognize the importance of clinical and research mentors. The single mentor/single mentee apprentice model may be strained by a number of factors. Senior faculty may experience increasing clinical or administrative responsibilities and may lack the dedicated time necessary to be a successful mentor. Our results agree with others who have identified the importance of mentorship networks.<sup>9,30,31</sup> While other studies have identified lack of sex-, race-, and ethnicity-concordant mentors in surgery as a major concern,<sup>32,33</sup> our results do not explicitly recognize this same concern. Although our results support diversity in surgical departments as a source of strength, a lack of diverse mentors did not emerge as a major barrier to success as a surgeon-scientist.

Formal education and research-oriented degrees (eg, doctorate or master's degree) were considered important but not essential for success. While a helpful adjunct, lack of a formal degree should not serve as a real or perceived barrier to success as a surgeon-scientist. Research-oriented formal education, however, should be encouraged for those surgical residents with the skills and aptitude for a career as a surgeon-scientist.

Financial concerns were recognized as a significant limitation for support of surgeon-scientists through the K Award mechanism. Ultimately, the chair of the surgery department mitigated these financial concerns by supporting only a limited number of surgeon-scientists. The decision to support certain candidates represents an important investment. Larger surgery departments or those with greater access to philanthropic funds may be more prepared to handle these financial challenges. Salary caps imposed on career development awards by the NIH may create significant financial challenges for individual surgeon-scientists.<sup>9</sup> If surgery departments are unable to supplement the K Awardee's salary to be commensurate with the salary of peers, there may be a disincentive to seek a K award. Intramural funding (philanthropy, endowments, etc.) should be leveraged to help support the development of surgeon-scientists and ultimately the advancement of surgical science.

The current paradigm for surgical training may not be the most effective way to develop surgeon-scientists. Since surgical trainees are often encouraged to pursue dedicated research time relatively early in their residency, many surgical trainees will require  $\geq 3$  uninterrupted years of clinical training before they transition to a faculty position. As such, they may not be as competitive as nonsurgeon colleagues who are typically encouraged to pursue dedicated research time at the end of their training or during fellowship training.

Without a recent track record or preliminary data, it may be very difficult for new faculty surgeons to be competitive for K Awards. Our results agree with others who have recognized this same concern.<sup>9,34</sup> This highlights a need to reconsider the current approach to resident research training. Residents might be encouraged to pursue research as part of fellowship training in addition to or instead of research during residency. Other options, such as a specific surgeon-scientist pathway for residents, might provide an enhanced training experience.

This study has a number of strengths, including a data set with insightful narratives, a purposive sample, and sound adherence to qualitative methodology. This study explores a timely area of interest to a broad group, including surgeons, surgical trainees, researchers, and administrators. This study, however, is not without limitations. Inherent to this type of study are concerns about generalizability: Our findings may not represent all academic surgical departments, especially those departments with no K Awardees. Furthermore, these results focus narrowly on the K Award mechanism and are not generalizable to all academic surgeons, especially those with different skillsets or career goals. These results do not compare perspectives, financial strain, or clinical demands between K Awardees and academic surgeons who found success through other viable pathways. Participants were somewhat homogenous in terms of race, ethnicity, and sex. They were selected, however, in a purposive manner, and thematic saturation was achieved, which should serve to minimize concerns about the veracity of the results.

As with other qualitative studies in which researchers collect data through interview techniques, the a priori assumptions and interests of the researchers may bias results. Objectivity may also be challenged secondary to tension between the researcher and the subjects being researched. In particular, tensions attributed to differences in experience, power, and rank may have contributed to loss of objectivity during data acquisition.

In conclusion, successful K Award recipients require institutional support, mentorship, and personal traits of resilience and perseverance. Institutional support for young academic surgeons pursuing K Awards is a complex investment with significant direct costs to the department in terms of financial contributions and lost clinical productivity. Chairs act as stewards of institutional resources and support those surgeon-scientists most likely to be successful in pursuit of a K Award. While our results recognize the K Award mechanism as one way to support and develop surgeon-scientists, the financial stressors and challenges inherent to this pathway may limit its utility and sustainability. Other mechanisms for the support and development of the surgeon-scientist need to be identified, developed, and encouraged to ensure the continued advancement of surgical science.

The investigators thank the K Awardees and Chairs for their participation in this study. Without their time and thoughtful engagement, this study would not have been possible.

#### SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at <http://dx.doi.org/10.1016/j.surg.2016.07.003>.

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